

ATTACHMENT D: INJECTION WELL PLUGGING PLAN

40 CFR 146.92(b)

CLEAN ENERGY SYSTEMS MENDOTA

1. Facility Information

Facility name: CLEAN ENERGY SYSTEMS
MENDOTA_INJ_1

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Well location: MENDOTA, FRESNO COUNTY, CA
LAT/LONG COORDINATES (36.75585015/-120.36440423)

Clean Energy Systems will conduct injection well plugging and abandonment according to the procedures below. Upon completion of the project, or at the end of the life of the Mendota_INJ_1 injection well, the well will be plugged and abandoned to meet the requirements at 40 CFR 146.92. The plugging procedure and materials will be designed to prevent any unwanted fluid movement, to resist the corrosive aspects of carbon dioxide/water mixtures, and to protect any USDWs. Any necessary revisions to the well plugging plan to address new information collected during logging and testing of the well will be made after construction, logging and testing of the well have been completed. The final plugging plan will be submitted to the UIC Program Director.

This attachment is one of the several documents listed below that was prepared by Schlumberger and delivered to Clean Energy Systems. These documents were prepared to support the Clean Energy Systems preconstruction application to the EPA.

- (Schlumberger, Attachment A: Summary of Requirements Class VI Operating, 2020)
- (Schlumberger, Attachment B: Area of Review and Corrective Action Plan, 2020)
- (Schlumberger, Attachment C: Testing and Monitoring Plan, 2020)
- (Schlumberger, Attachment D: Injection Well Plugging Plan, 2020)
- (Schlumberger, Attachment E: Post-Injection Site Care and Site Closure Plan, 2020)
- (Schlumberger, Attachment F: Emergency and Remedial Response Plan, 2020)
- (Schlumberger, Attachment G: Construction Details Clean Energy Systems Mendota, 2020)
- (Schlumberger, Attachment H: Financial Assurance Demonstration, 2020)
- (Schlumberger, Class VI Permit Application Narrative, 2020)
- (Schlumberger Quality Assurance and Surveillance Plan, 2020)

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2. Planned Tests or Measures to Determine Bottom-Hole Reservoir Pressure

Clean Energy Systems will conduct a downhole pressure test to determine reservoir pressure prior to plugging the injection well as required by 40 CFR 146.92(a). Once downhole pressure has been determined, CES will calculate kill fluid density. The test will be run using slickline or electric-line, based on availability.

Downhole Pressure Gauge Procedure

- Move in and rig up slickline unit
- Assemble slickline pressure control equipment and test for leaks
- Run in hole with downhole quartz gauge.
- Stop at 100 ft and record pressure for 5 mins.
- Proceed in hole and determine fluid level. Record fluid level depth. Pull up 50 ft and record pressure for 5 mins.
- Continue running in hole and take station reading every 2000 ft. until reaching perforation depth.
- Record pressure for 60 mins or until pressure variance is less than 1 psi in 15 mins.
- Pull out of hole, download data and confirm proper tool operation.
- Rig down slickline

3. Planned Internal Mechanical Integrity Test

Clean Energy Systems will conduct the tests listed in Table 1 to verify internal and external mechanical integrity prior to plugging the injection well as required by 40 CFR 146.92(a).

Table 1. Planned mechanical integrity tests (MITs).

| Test Description | Location |
|--|---|
| Surface Pressure Test | Wellhead |
| Ultrasonic & CBL | Wireline Well Log |
| Temperature using DTS | Wireline Well Log |
| Acoustic (or Noise) Log/Survey coupled with Temperature Log/Survey | Along wellbore using Distributed Acoustic Sensing (DAS); DAS equivalent or conventional wireline well log |

Surface Pressure Test Procedure

- Notify by phone California Department of Conservation a minimum of 24 hours prior to moving in rig as BOP testing must be witnessed by regulatory agency. DOGGR permit must be posted on site.
- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.

- Move in work-over rig and rig up.
- Install Blow-out Preventer Equipment and test to rated pressure.
- Pick up work string with bit and scraper and run in hole to bottom. Tag bottom and record depth. Circulate with well with brine appropriately weighted for bottom hole pressure and suitable for CO₂. Pull out of hole.
- Run in hole with retrievable bridge plug and set plug 20 feet above perforations. Release from plug, pull up 20 ft., then lower tubing and tag plug, apply 5000 lb weight on plug to confirm it is stationary.
- Raise tubing 30 ft., close surface valves and apply 1000 psi. Hold for 60 mins.
- Pressure Test is considered passing if total pressure drop for the test interval is less than 1% of start pressure.
- Results will be provided to regulatory agency.
- Pull out of hole

Contingency: In the event this test fails, CES will revert to other investigative methods as listed in Table 1; e.g., Temperature log using Distributed Temperature Survey. Detailed procedure for running these surveys can be found in (Schlumberger, Attachment C: Testing and Monitoring Plan, 2019).

4. Planned External Mechanical Integrity Test(s)

4.1 Ultrasonic Imaging Tool and Cement Bond Log (USIT and CBL)

Ultrasonic tool will provide both cement information and casing thickness measurements to determine casing mechanical integrity. The cement bond log in conjunction with Ultrasonic tool provides a comprehensive evaluation of cement quality and coverage.

USIT and CBL Logging Procedure

- Move in and rig up wireline logging unit
- Assemble Ultrasonic tool and cement bond log tool. Assemble wireline pressure control equipment and test for leaks.
- Ensure well is filled to surface with brine.
- Run in hole and record 500 ft of log
- Lower tool to total depth and record data to surface. Apply 500 psi of pressure and log to surface.
- Interpret log and determine casing integrity and cement coverage.

5. Information on Plugs

Clean Energy Systems will use the materials and methods noted in Table 2 to plug the injection well. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well as assessed during construction. The cement(s) formulated for plugging will be compatible with the stored carbon dioxide and water mixtures. The cement formulation and required certification documents will be submitted to the agency with the well plugging plan. Clean Energy Systems will report the wet density and will retain duplicate samples of the cement used for each plug. Cement volumes will be calculated using industry accepted equations for cement volumes, using open hole diameter, casing size, annular areas and total length of cement plugs, not inclusive.

Table 2. Plugging details.

| Plug Information | Plug #1 | Plug #2 | Plug #3 | Plug #4 |
|---|---------------|----------|----------|----------|
| Diameter of boring in which plug will be placed (in.) | 5.92 | 5.92 | 5.92 | 5.92 |
| Depth to bottom of tubing or drill pipe (ft) | 9637 | 7782 | 1950 | 100 |
| Sacks of cement to be used (each plug) | 145 | 51 | 51 | 20 |
| Slurry volume to be pumped (bbl) | 30 | 11 | 11 | 4 |
| Slurry weight (lb./gal) | 15.8 | 15.8 | 15.8 | 15.8 |
| Calculated top of plug (ft) | 8837 | 7582 | 1650 | 0 |
| Bottom of plug (ft) | 9637 | 7882 | 1950 | 100 |
| Type of cement or other material | CO2 Resistant | Class G | Class G | Class G |
| Method of emplacement (e.g., balance method, retainer method, or two-plug method) | Balanced | Balanced | Balanced | Balanced |

6. Narrative Description of Plugging Procedures

6.1 Notifications, Permits, and Inspections

In compliance with 40 CFR 146.92(c), Clean Energy Systems will notify the regulatory agency at least 60 days before plugging the well and provide updated (Schlumberger, Attachment D: Injection Well Plugging Plan, 2020), if applicable. Notification to State regulatory agencies will be provided and all required State permits will be acquired prior to starting operations.

The procedures described below are subject to modification during execution as necessary to ensure a plugging operation that protects worker safety and is effective to protect USDWs. Any significant modifications due to unforeseen circumstances will be described in the plugging report. Completed plugging report with charts and all lab information will be sent to the regulatory agency as required by permit. The plugging report shall be certified as accurate by CES and plugging contractor and shall be submitted within 60 days after plugging is completed.

6.2 Plugging Procedures

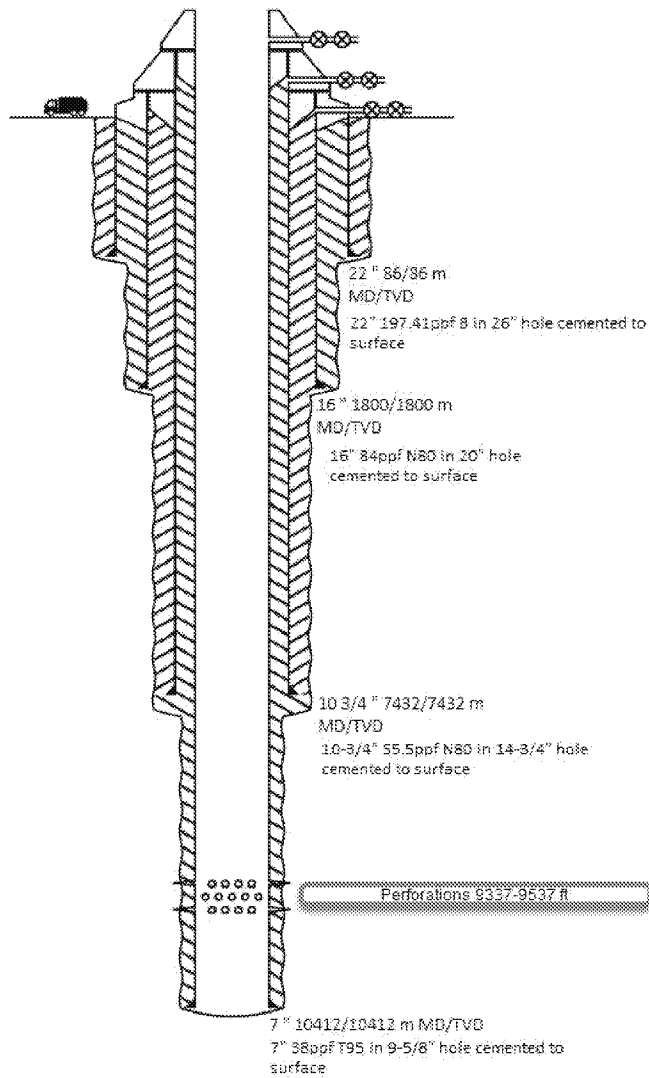
- Prepare location by removing all relevant landscaping/lighting fixtures as well as surface piping and electrical components as needed.
- Move in work-over rig and rig up.
- Install Blow-out Preventer Equipment and test to rated pressure.

- Move in work-over rig and rig up. Notify by phone California Department of Conservation a minimum of 24 hours prior to moving in rig.
- Pickup tubing and go to bottom.
- Circulate well clean with 9.4 ppg NaCl brine with corrosion inhibitor
- Rig up wireline unit and go in hole with gauge ring for 7", 38 lb casing (casing drift 5.795"). Make note of where fluid is tagged.
- Pick up wireline-set 13 Cr bridge plug and trip in hole. Set plug at +/- 9637'. Rig down wireline.
- Nipple up pack off on top of tubing head dressed for 3 1/2" tubing.
- Pick up existing 3 1/2" tubing and trip in hole to 9637ft.
- Tag bridge plug and apply 5,000 lbs. weight on bridge plug to make sure it is stationary. Raise tubing 5 feet.
- Rig cementers to well. Depending upon where fluid level was noted in Step 3 either go directly to mixing cement or mix 9.4 ppg NaCl brine with corrosion inhibitor to circulate well. Plan to mix brine if fluid level was lower than 115 feet below surface.
- Pump 10 bbl fresh water and then mix and pump 30 bbls Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.08 cu ft/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000lbs to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Recording pressures every 5 minutes
- Pressure should be maintained +/- 10% for 30 minutes. If not may need to wait and test cement again 4 hours later.
- Trip out of hole laying down work-string to +/- 7782'.
- Pump 10 bbl fresh water and then mix and pump 11 bbls Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 cu ft/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000lbs to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure.
- Close tubing and monitor pressure in tubing and tubular annulus. Recording pressures every 5 minutes
- Pressure should be maintained +/- 10% for 30 minutes. If not may need to wait and test cement again 4 hours later.
- Trip out of hole laying down work-string to +/- 1,950'. Pump 10 bbl fresh water and then mix and pump 11 bbls Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 cu ft/sk. Displace cement to spot as balanced plug.
- Trip out of the hole 100 ft above the plug and circulate well to clean cement from tubing.
- Wait 8 hours. Trip in and tag top of plug with ~ 10,000lbs to make sure plug is set.
- Pull back 10 ft and close in annulus and pressure well 500 psi above normal surface pressure.

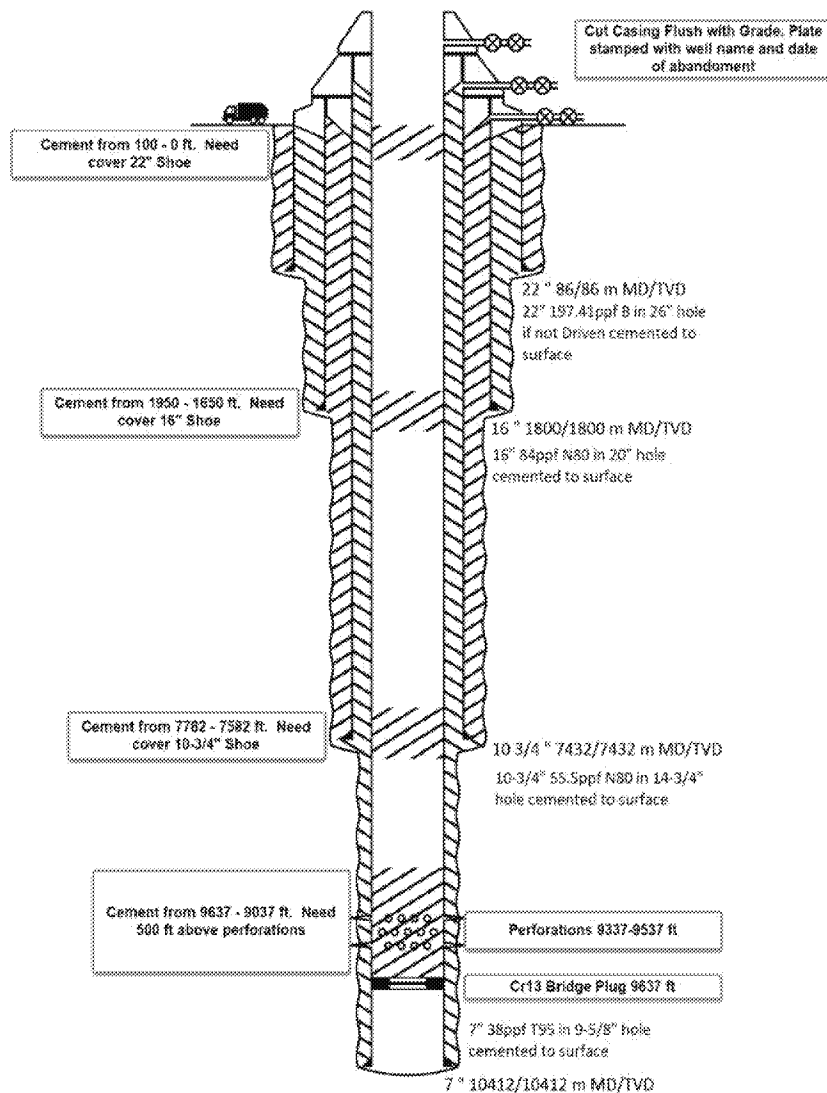
- Close tubing and monitor pressure in tubing and tubular annulus. Recording pressures every 5 minutes
- Pressure should be maintained +/- 10% for 30 minutes. If not may need to wait on test cement again 4 hours later.
- Trip out of hole laying down work-string to +/- 100'.
- Pump 5 bbls fresh water ahead.
- Pump 5 bbl fresh water and then mix and pump 4 bbls Class G cement with .5% dispersant. Mix at 15.8 ppg and yield 1.02 cu ft/sk. Displace cement to spot as balanced plug. Pull 3 ½ tubing out of hole laying down onto flatbed
- Cut off casing strings and casing heads and wellhead. Cut Flush with current grade. Final grade -1 ft. needs to be visible.
- Top off 7'' casing if necessary, with sacked cement.
- Weld plate over top of well. Needs to be visible.
- Rig down work-over rig and move out.

Contingency: Should any plug not pass the pressure test or hardness test a sample of the slurry shall be sent to the Cementing company's lab for analysis. Further, all pumping and mixing equipment shall be inspected for contamination or malfunction and appropriate corrective actions will be applied. A new batch of cement shall be blended and used on subsequent pumping operations. The previous plug will be drilled out, tubing will be placed accordingly, and a new plug will be pumped using the most recently designed cement chemistry. These remedial actions will be repeated until the plugging operation is completed.

6.3 Before Plug and Abandonment Well Diagram



6.4 Post Plug and Abandonment Well Diagram



7. References

- Schlumberger Quality Assurance and Surveillance Plan. (2020). *Quality Assurance and Surveillance Plan*.
- Schlumberger, Attachment A: Summary of Requirements Class VI Operating. (2020). *Attachment A: Summary of Requirements Class VI Operating and Reporting Conditions*.
- Schlumberger, Attachment B: Area of Review and Corrective Action Plan. (2020). *Attachment B: Area of Review and Corrective Action Plan 40 CFR 146.84(b) Clean Energy Systems Mendota*.
- Schlumberger, Attachment C: Testing and Monitoring Plan. (2019). *Attachment C: Testing and Monitoring Plan 40 CFR 146.90 Clean Energy Systems Mendota*.
- Schlumberger, Attachment C: Testing and Monitoring Plan. (2020). *Attachment C: Testing and Monitoring Plan 40 CFR 146.90 Clean Energy Systems Mendota*.
- Schlumberger, Attachment D: Injection Well Plugging Plan. (2020). *Attachment D: Injection Well Plugging Plan 40 CFR 146.92(B) Clean Energy Systems Mendota*.
- Schlumberger, Attachment E: Post-Injection Site Care and Site Closure Plan. (2020). *Attachment E: Post-Injection Site Care and Site Closure Plan 40 CFR 146.93(A) Clean Energy Systems Mendota*.
- Schlumberger, Attachment F: Emergency and Remedial Response Plan. (2020). *Attachment F: Emergency and Remedial Response Plan 40 CFR 146.94(A) Clean energy Systems Mendota*.
- Schlumberger, Attachment G: Construction Details Clean Energy Systems Mendota. (2020). *Attachment G: Construction Details Clean Energy Systems Mendota*.
- Schlumberger, Attachment H: Financial Assurance Demonstration. (2020). *Attachment H: Financial Assurance Demonstration 40 CFR 146.85 Clean Energy Systems Mendota*.
- Schlumberger, Class VI Permit Application Narrative. (2020). *Class VI Permit Application Narrative 40 CFR 146.82(A) Clean Energy Systems Mendota*.